Measure: Residential Direct Load Control Program (G6b)

Promote the deployment by Tucson Electric Power company (TEP) of two-way residential direct load control in ~13.5% of owner-occupied single-family residences in the City per year starting in 2013 until 100% deployment is reached by the end of 2020.

Emission reduction potential by end of 2020:	~125,000 tCO_2e / yr.
Percentage of goal (2020):	5.5%
Total annual average implementation costs 2013-2020:	$7.0 million
Entity that bears the costs of implementation:	Tucson Electric Power (customers and/ or shareholders)
Cost/Savings per tCO_2e in 2020:	Savings $49 / tCO_2e
Net annual savings beginning 2021:	~$15 million
Entity that realizes the financial return:	Residential electricity consumers
Equitability (progressive/regressive, income/revenue neutral, etc):	Likely positive
Potential unintended consequences:	Minimal

Note: Westmoreland Associates projects over the 20-year life of a Direct Load Control system (a smart meter or any other dynamic time-of-use system) a 10% household electricity reduction. Installation costs are projected to be (in consultation with TEP) $450 per system.

The measure's costs (to TEP or ratepayers or both) exceed its savings to homeowners by ~$3 million from 2013-2020.

Over the 20-year lifetime of the DLC systems installed in single-family homes, net savings to homeowners are projected to be ~$337 million, resulting in net savings per tCO_2e saved of $107.

Background information:

Smart meters are one form of direct load control available to electric utilities. Such meters are often all-digital devices that precisely track electric energy usage and transmit data directly to a customer's utility. Some smart meters (such as those manufactured by Itron) include advanced features that allow the meters to communicate with "smart" thermostats and appliances, allowing remote activation of electric service at the customer's convenience. The meters also measure up-to-the-minute electricity usage, and display consumption in a consumer-friendly format that allows customers to track their own usage and costs.

The new metering technology is encouraging greater energy conservation by giving electricity consumers the ability to monitor and manage better their electricity use and costs in near real-time. Various types of smart meters and other direct load control systems are available commercially and are now in use around the country.

Other load demand approaches are web-based, automatic load reading technologies that instantaneously record demand for HVAC services in a participating household and relay this information to customers via their broadband (home computer) systems. Customers can then adjust their thermostat to reduce demand for heating or cooling.

Business as Usual:

The nation is moving towards deployment of a smart grid, with increasing numbers of utility customers among the early adopters due to aggressive deployment strategies by these utilities.

In Tucson, TEP is about to pilot a "Power Partners Project involving 600 homes (and 200 small commercial customers) in an effort to determine energy savings which accrue when customers have access to real time demand and price information. The pilot will be monitored from the beginning, with at least a year's data being needed to understand the behavioral change and energy conservation that results from more instantaneous energy pricing information for air conditioning use being available to customers.[1]

TEP notes that it operates in a less-volatile grid situation than some utilities in other regions of the country, meaning it experiences less fluctuation in demand over time that might otherwise interest a utility in smoothing peaks and customers in reducing peak load pricing.[2] Partly for this reason, TEP has decided not to move to current in-the-home smart metering but rather focus on load reduction via a customer broadband interface.

Apart from this pilot program, TEP employs DemandSmart and PowerShift programs which are earlier versions of load control approaches which include time of use pricing as a key component but lack the interface with individual appliances and do not provide for two-way communication in real time between the utility and customers.

In the absence of a more dynamic direct load control approach such as that being piloted by TEP residential electricity ratepayers will likely not achieve easy energy efficiency cost savings until either rate increases occur or specific time of use pricing information systems become available.

The measure encourages the City to support TEP's Power Partners Project as it represents an opportunity for Tucson residents to be on the early edge of a national trend that is expected to become ubiquitous within the decade.

Description of Measure and Implementation Scenario:

To assist and accelerate this effort, the City could work closely with TEP to remove any code, institutional, or policy barriers now in place such that a maximum program of direct load control technology in residential homes could be realized.

This measure calls for the City to work with TEP to promote its Power Partners Project above and beyond the initial pilot stage, using savings data gleaned from the pilot period to drive expansion of the program to a wider residential audience: all owner-occupied single-family homes by 2020.

The project would aim to install systems in ~13.5% of owner-occupied single-family homes each year through 2020. This amounts to 14,471 of the owner-occupied single-family homes (107,000) projected to be in the City of Tucson in 2013.[3] By the end of 2020, over 124,500 homes will have the systems.

Has the Measure been implemented elsewhere and with what results:

Smart meter programs, a type of direct load control technology, are being implemented on a city scale worldwide. For example, beginning in late 2009 **Southern California Edison** started to install the first of 5 million smart meters in its customer service area.[4]

In **Houston, Texas**, there were 45,000 smart meters installed and operational as of August 2009, and more than 2 million are expected to be in place by the end of 2012.[5] The Texas legislature and the Public Utility Commission of Texas authorized utilities to assess Retail Electric Providers a surcharge to cover the cost of smart meters.

The surcharge, to be spread over a 12-year period, amounted to $3.24/month for each residential customer for the first 24 months, beginning in February 2009; thereafter the surcharge was reduced to $3.05/month.[6] A federal Smart Grid grant may help reduce the duration and thus expense of this surcharge.

Smart Meter programs are also in place in Ontario, Canada, and in Europe.[7]

In **Illinois**, where a program has been in place for several years, about 95% of the participants saved money (2007 data) in Commonwealth Edison's open-enrollment residential real-time pricing program, thought to be the nation's first at the time. The majority of residential customers had electricity and cost savings of between 7% and 12% according to utility reports.[8]

A recent U.K. study suggests that smart meters are capable of delivering a 10% cut in annual energy use.[9]

Energy/Emission analysis:

Average residential electricity consumption in Tucson is 11,000 kWh/year.[10] Performance data from direct load control technologies such as existing smart meter programs indicate savings in the 7-15 percent range per residence per year.[11]

The annual kWh savings assumption for this measure will be 10%, a mid-point value from the above range. Actual savings can be calculated at the end of each year using pre-program benchmark data, and exact utility billings going forward. A 10% annual reduction in home electricity consumption amounts to a savings of 1,100 kWh/year.

The measure calls for the installation of direct load control technology in ~13.3% of Tucson homes in 2013, and each year 2014-2020 to achieve a stretch goal that by end of 2020, 100% of City single-family homes have some form of dynamic, direct load control technology installed.

Westmoreland Associates believes that such levels of deployment will become increasingly more likely as energy costs rise throughout the decade, though the pace of implementation can be significantly advanced with an active education and promotion campaign as envisaged in this proposal.

The annual kWh, tCO_2e and dollar savings projections below assume that the first year a system is installed, one-half year's savings are achieved since the systems will have an average of six months of use if installed throughout the year.

Tucson Electric Power reports its most recent (2008) CO_2/kWh emission factor at ~2 pounds per kWh.[12] A reduction in individual residential electricity use of 1,100 kWh due to deployment of a Direct Load Control system would result in a GHG reduction of 1.0 tCO_2e/year (1,100 kWh/year x 2.0 pounds CO_2/kWh divided by 2,205 pounds/metric ton = 1.0 tCO_2e/year).

This analysis uses an estimate of 103,250 owner-occupied, single-family homes in the TEP service area within the Tucson city limits in 2011, and assumes that the count grows in proportion to the County's expected population growth of 1.9%/yr. Total homes with DLC by end of 2020 is 124,633.

At full deployment in 100% of Tucson single-family homes by 2021, the measure would result in electricity savings of 274 million kWh/year, resulting in GHG reductions of 124,228 tCO_2e (unless TEP's carbon emissions per kWh delivered changes by 2020 – it is likely to decrease due to Arizona's renewable portfolio standards and other TEP investments).

Assuming the direct load control systems have a 20-year life, each installation means 20 years of an 1100 kWh annual savings per household, or a 22,000 kWh and ~20 tCO_2e savings per household. The total Tucson savings over the life of the systems is about 2.5 million tCO_2e. The lifecycle savings are used in the economic impact analysis, but not the tCO_2e analysis.

Climate Change Impact Summary in tCO_2e:

COT 1990 Citywide GHG emissions (baseline):	5,461,020
MCPA 7% reduction target for COT:	5,078,749
2012 BAU GHG emissions projection:	7,000,000
2020 BAU GHG emissions projection:	7,343,141
GHG emissions reduction to meet 7% goal (2012):	1,921,251
GHG emissions reduction to meet 7% goal (2020):	2,264,392
Contribution of this Measure in 2021 and beyond per year (full deployment)	125,101

Economic analysis:

Measure Costs

This analysis assumes that each direct load control system installed has a 20-year life and could cost approximately $450 to install (prices should drop once an economy of scale is reached in program implementation). The Houston Center Point Energy project cited above, using smart meters to achieve similar energy reductions, expects its residential meters to cost approximately the same.[13]

By full system deployment at the end of 2020, ~$56 million will have been invested in 124,510 homes.

Measure Benefits

At a residential electricity rate of $0.08 / kWh and rising 2.4% per year as projected by Westmoreland Associates, the installation of the systems in 13.5% of single-family homes per year starting in 2013 results in the annual savings to Tucson residents exceeding the installation costs by 2015.

By full deployment at the end of 2020, savings are projected to be ~$13.7 million, rising with electricity prices 2.4% annually to $36 million by 2032.

On a household basis, each $450 meter is projected to save ~$2,334 in electricity costs during its 20-year life, depending on when the system is installed.

Net Economic Impact

From 2013 through 2021, the savings are ~$53 million achieved for installation costs of $56 million, resulting in a net loss of ~$3 million.

Over the lifetime of the systems installed 2013-2020, the $56 million invested will save residents ~$337 million, for a net savings of ~$281 million.

The net economic impact is projected at 1.5 times the net savings of $281 million = $422 million.

The net savings per tCO2e over the lifetime of the systems is $107.

Program costs are assumed to be met by the utility, while demand reduction benefits are received by both the utility (in its capacity planning calculations and avoided power plant construction) and the homeowners (in the form of lower electricity bills).

Co-benefits:

Reduced electricity demand through use of direct load control systems such as TEP is piloting is expected to save consumers money on an annual basis. The greater that such systems drive energy conservation beyond the target reductions expected, the greater the energy cost savings to the participants and the lower the GHG emissions associated with reduced electricity demand.

Any measure that saves consumers money through lower utility costs frees capital for other potential energy efficiency measures that would be consistent with a climate adaptation strategy. More energy efficient homes become more of an asset in times of a warmer, drier climate and buffer residents against additional energy cost increases expected as a price on carbon becomes more formally established.

Equitability:

A positive equitability effect is projected. Direct load control systems will be likely to save more kWh in higher income households that have higher electricity consumption, but since the utility will install the systems at no cost to consumers (with its costs likely spread over all consumers in the rate base), the savings accruing to lower income households are likely to represent a higher percentage of disposable income, especially if electricity rates increase at a faster rate than typical lower income wage rates.

Potential unintended consequences:

Early adaptation of direct load control systems, particularly in certain smart meter programs, has created some initial consumer questions regarding billing accuracy. These were subsequently resolved along with recommendations for a more comprehensive education program to accompany meter deployment in those situations.

Privacy concerns were also initially raised in some instances, however utilities note they have been always able to track customer usage of their electricity product by time of use. The principal new feature of direct load control systems is developing consumer awareness of time-of-use price implications that are intended to influence electricity consumption behavior.

Endnotes

[1] Communication with Jeff Hunter, TEP. January 24, 2011.

[2] Communication with Denise Richerson Smith, TEP. January 24, 2011.

[3] The projection is based on 103,250 owner-occupied single-family homes in City of Tucson according to AmericanTowns.com at: http://www.americantowns.com/az/tucson-information. Westmoreland Associates projects the number to rise with the PAG projection of a regional population increase of 1.89% per year.

[4] Science and Technology. September 22, 2008. http://www.treehugger.com/files/2008/09/southern-california-edision-smart-connect-smart-meter-program.php.

[5] Center Point Energy. http://www.centerpointenergy.com/services/electricity/residential/smartmeters/.

[6] Centerpoint Energy. http://www.centerpointenergy.com/services/electricity/business/advancedmetering/faq/1997532bbadb6210VgnVCM10000026a10d0aRCRD/.

[7] IESO. http://www.ieso.ca/imoweb/siteShared/smart_meters.asp?sid=ic.

[8] Science and Technology. May 7,2008. http://www.treehugger.com/files/2008/05/smart-power-meters-real-time-pricing-energy-electricity.php.

[9] The Telegraph. November 28, 2008. http://www.telegraph.co.uk/earth/earthcomment/3534211/Smart-metering-is-essential-to-hit-2050-carbon-emission-targets.html.

[10] Communication with Denise Richerson Smith, TEP. April 2009.

[11] A Department of Energy study concluded that up to 15% could be saved by households. See: Stephen Johnson, SmartSynch, “Built-in Reminders to Conserve,” Bloomberg Businessweek magazine debate “Smart Meters: Not So Brainy,” March 2010, at: http://www.businessweek.com/debateroom/archives/2010/03/smart_meters_not_so_brainy.html.

[12] Regional Greenhouse Gas Inventory. PAG. October 2008.

[13] Current estimates of installed costs for smart meters range from as low as $100 to as high as $500.